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PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

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in its capacity as elected Office

Date of mailing (day/month/year) 20 November 2000 (20.11.00)	
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International filing date (day/month/year) 13 April 2000 (13.04.00)	**Priority date** (day/month/year) 20 April 1999 (20.04.99)
Applicant DZERMEJKO, Albert, John et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

18 October 2000 (18.10.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

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NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

HANSEN, Willem, Joseph, Maria
Corus Technology BV
P.O. Box 10000
NL-1970 CA Ijmuiden
PAYS-BAS

Date of mailing (day/month/year)
14 December 2000 (14.12.00)

Applicant's or agent's file reference
HO990PCT/Zu/Kh

IMPORTANT NOTIFICATION

International application No.
PCT/EP00/03505

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13 April 2000 (13.04.00)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [X] the agent [ ] the common representative

Name and Address
HANSEN, Willem, Joseph, Maria
Hoogovens Corporate Services BV
P.O. Box 10000
NL-1970 CA IJmuiden
Netherlands

State of Nationality:
State of Residence:
Telephone No.: +31 251 496956
Facsimile No.: +31 251 470252
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address
HANSEN, Willem, Joseph, Maria
Corus Technology BV
P.O. Box 10000
NL-1970 CA Ijmuiden
Netherlands

State of Nationality:
State of Residence:
Telephone No.: +31 251 496956
Facsimile No.: +31 251 470252
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

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1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
A. Karkachi

Telephone No.: (41-22) 338.83.38

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(71) Applicant (*for all designated States except US*): DANIELI CORUS TECHNICAL SERVICES BV [NL/NL]; P.O. Box 10000, NL–1970 CA IJmuiden (NL).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): DZERMEJKO, Albert, John [US/US]; 111 Derby Trace, Nashville, TN 37211–7302 (US). LAJTONYI, Alex [CA/CA]; 680 Ramsgate Road, Burlington, Ontario L7N 2Y3 (CA). BLEIJENDAAL, Nicolaas, Gerardus, Jacobus [NL/US]; 135 Woodland Drive, Pittsburgh, PA 15228–1714 (US). VAN STEIN CALLENFELS, Johan, Egenolf [NL/NL]; Goeman Borgesiuslaan 8, NL–1981 CP Velsen–Zuid (NL).

(74) Agent: HANSEN, Willem, Joseph, Maria; Hoogovens Corporate Services BV, P.O. Box 10000, NL–1970 CA IJmuiden (NL).

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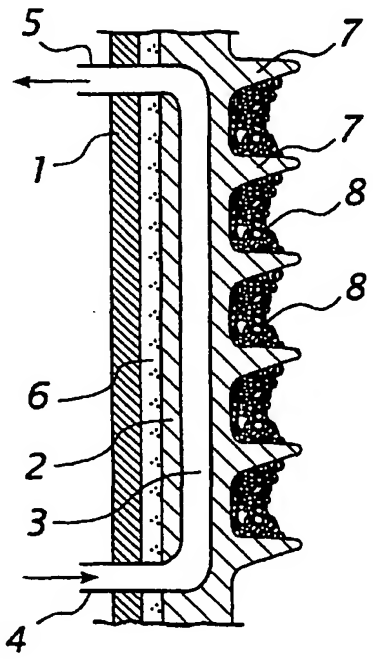
(54) Title: COOLING PANEL FOR A SHAFT FURNACE, SHAFT FURNACE PROVIDED WITH COOLING PANELS OF THIS NATURE, AND A PROCESS FOR PRODUCING SUCH A COOLING PANEL

(57) Abstract

Cooling panel for a shaft furnace of the type through which at least one vertical duct runs, the ends of which are connected to connection ends running transversely with respect to the plane of teh cooling panel, in which furthermore each duct and the connection ends are formed from a continuous tube made from a material selected from the group consisting of low–carbon steel, stainless steel and an alloy which predominantly copmrises Cu and Ni with an Ni content of ≥ 28 % by weight, and the remainder of the cooling panel consists of copper which is cast around this tube, the cooling panel being provided, on the side remote from the connection ends, with a multiplicity of horizontal ribs.



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COOLING PANEL FOR A SHAFT FURNACE, SHAFT FURNACE PROVIDED WITH COOLING PANELS OF THIS NATURE, AND A PROCESS FOR PRODUCING SUCH A COOLING PANEL

The invention relates firstly to a cooling panel for a shaft furnace of the type through which at least one vertical duct runs, the ends of which are connected to connection ends running transversely with respect to the plane of the cooling panel. The invention furthermore relates to a shaft furnace provided with a jacket, the jacket being provided on the inside with cooling panels of this nature. In this context, the jacket is understood to mean the metal casing of the furnace. Finally, the invention relates to a process for producing the novel cooling panels.

A standard embodiment of a shaft furnace is a blast furnace for the reduction of iron ore. However, shaft furnaces are frequently also used for other purposes. Where the following text explains the invention with reference to applications for a blast furnace, this description also comprises applications for other types of shaft furnaces.

The thermal loads imposed on the wall of a blast furnace are generally extremely high. These thermal loads may, for example, be of the order of magnitude of 250 000 W/m^2. To prevent damage to the metal casing of the furnace, it is therefore necessary to provide this wall with a cooling system. One of the means which is frequently employed for this purpose is the use of so-called cooling panels. These are metal panels which are attached to the inside of the steel casing, also known as jacket or steel jacket, at least one vertical duct running through these cooling panels. These ducts are then connected to connection ends which run through the jacket. That side of the cooling panel which faces towards the inside of the furnace may be provided with recesses in which refractory bricks are fitted, in order to avoid or at least reduce direct thermal contact between the hot furnace charge and the cooling panel. Unlined cooling panels are also used, however, in which case the cooling panel is cooled so intensively that a solidified crust is formed against them. This solidified crust consists of slag constituents and constituents of the charge inside the furnace.

Traditionally, cooling panels are made from cast iron. However, it has been found that cast iron panels can lead to problems if the refractory lining becomes worn or if parts of the crust break or melt off. Specifically, a sudden increase in the thermal load on the cooling panel, partially owing to structural changes in the material of the cooling panel, may give rise to deformation of the cooling panel and movements thereof which, especially if they are repeated a number of times, may lead to cracks and leaks in the water ducts. To some extent, leaks of this nature can be avoided by closing off ducts. If there are a number of leaks, it may be necessary to shut down the furnace and carry out emergency repairs.

Previously, it has been proposed to reduce these drawbacks by casting the cooling panels not from cast iron but from copper. Due to the better thermal conductivity of copper, such a panel can tolerate higher thermal loads, while temperature differences within the cooling panel are lower. Consequently, this also reduces the risk of leaks and cracking in the cooling panel. Nevertheless, it has been found that even with cast copper cooling panels problems may arise in the long term, inter alia as a result of fatigue phenomena in the material and owing to casting defects present in cast copper cooling panels. In US 4,382,585, it is proposed to eliminate these drawbacks by producing a cooling panel not by casting copper, but rather by machining a thick rolled or forged copper sheet. In this case, the ducts are drilled through this sheet and in some cases blocked again at the ends. This design has also proven to have drawbacks. Blocking the ends of the ducts may again lead to leakage. Also, the shape of such cooling panels is limited owing to the way in which they are produced. A profiled surface on the furnace side can only be achieved at high cost, while the drilling of long ducts limits the length of the cooling panels. Generally, one drawback of the known copper cooling panels is that the connection ends also consist of copper. In many cases, copper is too soft to make mechanical connections for the cooling panels.

Therefore, there is a need for a cooling panel which consists predominantly of copper and does not have the drawbacks described. Moreover, this cooling panel is to be of a form which reduces the thermal loads and allows a stable crust to form, providing additional protection and thermal insulation for the cooling panel.

It has been found that such a cooling panel according to the invention can be obtained if, in this cooling panel, each duct and the connection ends are formed from a continuous tube made from a material selected from the group consisting of low-carbon steel, stainless steel and an alloy which predominantly comprises Cu and Ni with an Ni content of $\geq 28\%$ by weight, and the remainder of the cooling panel consists of copper which is cast around this tube, the cooling panel being provided, on the side remote from the connection ends, with a multiplicity of horizontal ribs. Preferably the ribs have a length, in the width direction of the cooling panel which is smaller than the width of the cooling panel.

More preferably the ribs have a length in the said width direction of the cooling panel of $\leq 50\%$, preferably $\leq 25\%$ of the width of the cooling panel. The copper/nickel alloy as described has a higher melting point than copper, with the result that the copper body of the cooling panel can be cast around these tubes without the tube itself also melting. It has proven possible to form copper-nickel alloys with a high nickel content into high-quality tubes which are generally used for heat-exchanger pipes under exacting mechanical, thermal and chemical conditions. Even if the cast copper body begins to exhibit pores or cracks, there will still be no leakage of water owing to the

high quality of the tube used. By furthermore providing the cooling panel with ribs on the side facing towards the furnace content, spaces are formed between these ribs, in which spaces a crust can form. The crust can consist of slag, ore, iron or a mixture thereof. Also, the crust can have been prepared by applying refractory bricks, concrete or masses between the ribs. If the ribs taper, that means that the heat flux to the main body of the cooling panel is reduced, which is of benefit to the durability of the cooling panel. By positioning a plurality of ribs next to one another on the cooling panel and making them short, it is also possible to avoid high thermal stresses in these ribs, so that they themselves also have a longer service life.

However, according to the invention, the ribs may also be shaped such that they thicken towards their free ends remote from the main body of the cooling panel. This prevents the loosening of the crust from within the ribs, which guarantees an extra protection of the cooling panel.

It should be noted that US patent No. 3,853,309 has disclosed a water-cooled blowing nozzle in which a copper/nickel tube is also cast in copper over part of its length. However, the use of blowing nozzles in a blast furnace in technical terms relates to a completely different problem from that of cooling a furnace wall with the aid of cooling panels.

According to the invention, an alloy which contains between 65 and 70% by weight Ni, approx. 3% by weight Fe and $\leq$ 1% of one or more of the elements Mn, Si and C has proven to be a particularly suitable material for the continuous tube according to the invention. The use of Monel, which has a composition of approx. 28% Cu, 68% Ni, 3% Fe, 1% Mn and low Si and/or C contents, is particularly preferred.

An important function of the ribs is that they allow a crust to form on the surface of the cooling panel, and in particular they are also able to hold this crust in place. The latter factor is also of undoubted importance in view of the fact that the charge which is moving continuously down the blast furnace exerts a high frictional force on the wall and thus, in particular, on the crust formed. Ultimately, a large part of this frictional force is absorbed by the ribs, which thereby run the risk of becoming damaged. To ensure that these ribs are well able to withstand this frictional force, it has proven highly advantageous, according to the invention, to provide these ribs with supporting backs. These supporting backs ensure that the vertical load imposed is better absorbed and distributed by the cooling panel. As a result, the risk of the ribs being deformed, breaking off or being damaged in some other way is reduced.

In a first embodiment of these ribs with a supporting back, each of the ribs with a supporting back is T-shaped in cross section, parallel to the plane of the cooling panel. According to another embodiment, each of the ribs with supporting backs has a cross section in the shape of a +, parallel to the plane of the cooling panel.

At locations where the frictional force of the falling charge may be extremely high, it may be advisable to provide the ribs with a plurality of supporting backs. According to one possible embodiment according to the invention, for this purpose the ribs are provided with supporting backs on either side in the vicinity of their ends.

Copper as a material for cooling panels is considerably more expensive than cast iron. However, owing to the much better thermal conductivity of copper than that of iron, it has proven possible to save considerable amounts of material through the shape of the cooling panel. In one possible embodiment of the cooling panel, for this purpose the wall is provided with undulating recesses on the side of the connection ends, on either side of each duct, in which recesses reinforcing walls which fill up the recesses are distributed over the height of the cooling panel. Despite the fact that the cooling panel has consequently been locally thinned, it remains sufficiently strong. Optionally in combination with these undulating recesses on the side of the connection ends, it has also proven possible, in another embodiment of the cooling panel according to the invention, to provide the wall on the side remote from the connection ends with undulating recesses on either side of each duct. This also allows considerable amounts of material to be saved.

In addition to the cooling panel described, the invention also relates to a shaft furnace provided with a jacket which on the inside is at least partially provided with the cooling panels described above.

Finally, the invention also relates to a process for producing a cooling panel of one of the types described above. This process is characterized in that the continuous tube (or tubes) is firstly given its final shape, after which the copper for the cooling-panel body to be formed is cast around it at a temperature which is so close to the melting point of the tube material that, after the cast material has cooled, it is attached to the tube material. This method results in there being virtually no resistance to the passage of heat between the continuous tube and the surrounding copper of the cooling panel. In this context, it should be noted that the term copper is to be understood as meaning not only completely pure copper but also low alloy copper with a composition such as that which is customarily used for the production of copper cooling panels.

The invention will now be explained with reference to a number of diagrammatic figures.

Fig. 1 shows a longitudinal section through a cooling panel.

Fig. 2 shows a detail of this panel on an enlarged scale.

Fig. 3 shows part of a cross section through the cooling panel shown in Fig. 1, on an enlarged scale.

Fig. 4 shows a perspective view illustrating the detail from Fig. 2.

Fig. 5 shows a possible configuration of ribs with supporting backs.

Fig. 6 shows smaller ribs in larger numbers.

Fig. 7 shows ribs with additional supporting backs.

Fig. 8 shows yet another configuration of the ribs with supporting backs.

In Figs. 1 and 3, (1) denotes the steel casing of a blast furnace (the so-called jacket). A cast copper cooling panel body is denoted by (2), through which a cast-in tube (3) runs. This tube is made from Monel. The connection ends (4) and (5) of the continuous tube (3) project through openings in the jacket (1), through which cooling water from outside the furnace can circulate through the cooling panel inside the furnace and thus cool this panel. As can be seen from Fig. 3, it is possible for a plurality of continuous tubes (3) to be cast into the cooling panel (2).

The space between the jacket (1) and the cooling panel may be filled up with a casting compound (6). Attachment bolts for attaching the cooling panel to the jacket (1) from outside the furnace are not shown. This attachment method is of a traditional nature, as is customarily used in cooling panels.

Tapering ribs (7) are cast onto the furnace side of the cooling panel. These ribs (7) may be distributed over the surface of the panel in a pattern such as that shown in Fig. 5. Since the length of these ribs is limited, it will be impossible for high thermal stresses to build up in these ribs. A vertical frictional force which a downwardly moving charge may exert on the ribs can be absorbed by supporting backs (9) (cf. Fig. 2 and Fig. 5).

Solidifying crust material (8) may collect between the ribs, and if appropriate the supporting backs, forming thermal insulation between the furnace content and the cooling panel. The shape of the ribs prevents the possibility of this crust being torn off again easily by the downwardly moving charge. Furthermore, the tapering form of the ribs limits a high thermal load on the cooling panel via the ribs. As the crust (8) becomes thicker, that part of the ribs which is exposed to heat will become smaller.

If, after prolonged use of the cooling panels and/or as a result of fluctuating thermal loads on these panels as a result of highly divergent operating conditions, the cooling panels should become damaged, this damage will be limited to small cracks (13) in the vicinity of the outer edge of the ribs, as indicated in Fig. 4. It has been found that damage of this nature remains limited and certainly will not propagate into the main body of the cooling panel. Even if damage were to arise in that area as a result of extreme operating conditions, this does not lead to damage to the cast-in Monel tubes.

Fig. 3 furthermore shows how it is possible to save copper during the construction of the cooling panels by making that wall (11) of the cooling panel which faces towards the jacket (1) undulate around the tubes (3). The strength of the cooling panel can be maintained by arranging reinforcing walls (12) in the recesses formed, distributed over the height of the cooling panel.

In a similar way, it is also possible to make that surface (10) of the cooling panel which faces towards the furnace content undulating.

The ribs (7) can be made larger or smaller depending on whether it is desired for them to penetrate more or less deeply into the furnace. Fig. 6 shows an embodiment in which smaller ribs (7) with supporting backs (9) are arranged in a more tightly packed pattern.

If working under conditions in which it is possible to expect extremely high frictional forces from a downwardly moving charge, it is recommended for each rib to be provided with a multiplicity of supporting backs. In the embodiment shown in Fig. 7, four supporting backs (15-18) are arranged on each rib (14). This shape provides an additional resistance to a crust (8) which has formed being torn off.

Fig. 8 shows yet another embodiment (20) of the ribs with supporting backs. These are in the form of upright crosses.

CLAIMS

1. Cooling panel for a shaft furnace of the type through which at least one vertical duct runs, the ends of which are connected to connection ends running transversely with respect to the plane of the cooling panel, in which furthermore each duct and the connection ends are formed from a continuous tube made from a material selected from the group consisting of low-carbon steel, stainless steel and an alloy which predominantly comprises Cu and Ni with an Ni content of $\geq 28\%$ by weight, and the remainder of the cooling panel consists of copper which is cast around this tube, the cooling panel being provided, on the side remote from the connection ends, with a multiplicity of horizontal ribs.

2. Cooling panel according to Claim 1, characterized in that the material of the continuous tube contains between 65 and 70% by weight Ni, approx. 3% Fe and $\leq 1\%$ of one or more of the elements Mn, Si and C.

3. Cooling panel according to Claim 2, characterized in that the material of the continuous tube consists of Monel, with a composition of approx. 28% Cu, 68% Ni, 3% Fe, 1% Mn and low Si and/or C contents.

4. Cooling panel according to one of claims 1-3, characterized in that the ribs have a length, in the width direction of the cooling panel, which is smaller than the width of the cooling panel.

5. Cooling panel according to claim 4, characterized in that the ribs have a length in the width direction of the cooling panel of $\leq 50\%$, preferably $\leq 25\%$, of the width of the panel.

6. Cooling panel according to one of Claims 1-5, characterized in that the ribs are provided with supporting backs.

7. Cooling panel according to Claim 6, characterized in that each of the ribs with a supporting back is T-shaped in cross section, parallel to the plane of the cooling panel.

8. Cooling panel according to Claim 6, characterized in that each of the ribs with supporting backs are in the shape of a + in cross section, parallel to the plane of the cooling panel.

9. Cooling panel according to Claim 6, characterized in that the ribs are provided with supporting backs on either side in the vicinity of their ends.

10. Cooling panel according to one of Claims 1-9, characterized in that the wall is provided, on the side of the connection ends, on either side of each duct, with undulating recesses in which reinforcing walls which fill up these recesses are distributed over the height of the cooling panel.

11. Cooling panel according to one of Claims 1-10, characterized in that the wall, on the side remote from the connection ends, is provided, on either side of each duct, with undulating recesses.

12. Cooling panel according to Claim 1, characterized in that the ribs thicken towards their free ends remote from the main body of the cooling panel.

13. Shaft furnace provided with a jacket which on the inside is at least partially provided with cooling panels according to one of Claims 1-12.

14. Process for producing a cooling panel according to one of Claims 2-13, characterized in that the continuous tube (or tubes) is firstly given its final shape, after which the copper for the cooling-panel body to be formed is cast around it at a temperature which is so close to the melting point of the tube material that, after the cast material has cooled, it is attached to the tube material.

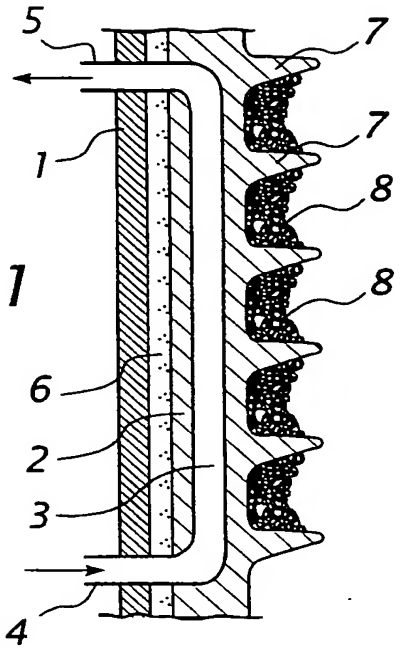


Fig. 1

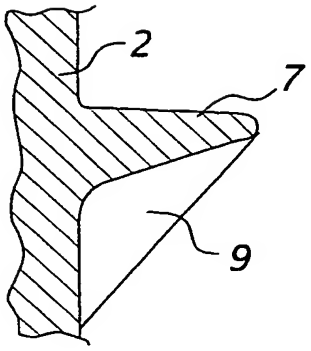


Fig. 2

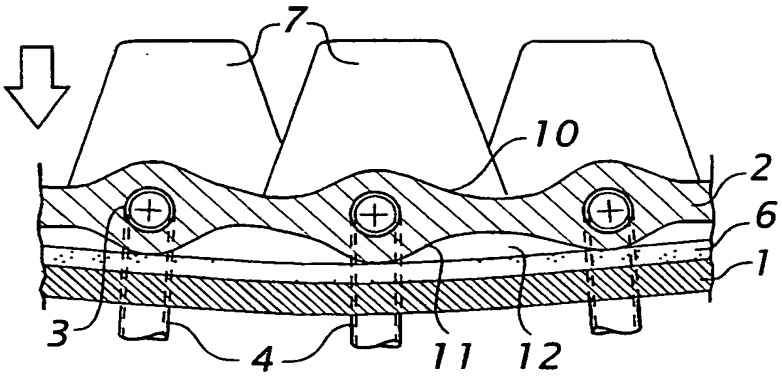


Fig. 3

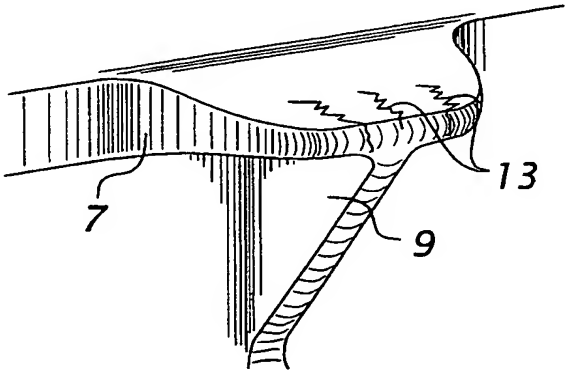


Fig. 4

Fig. 5

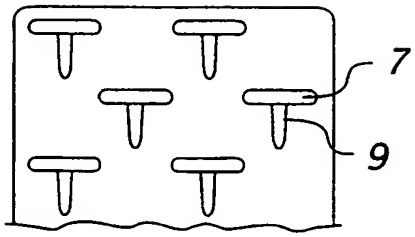


Fig. 6

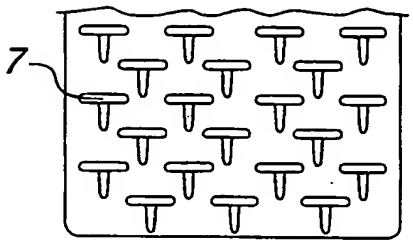


Fig. 7

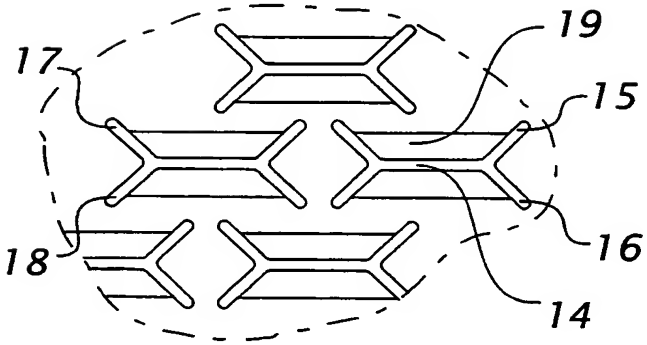
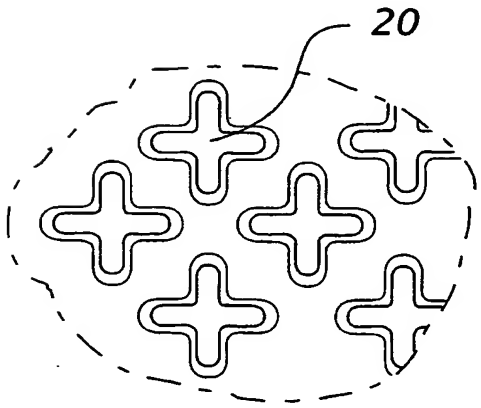


Fig. 8



INTERNATIONAL SEARCH REPORT

International Application No
PC[redacted] 00/03505

A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3 853 309 A (WIDMER C) 10 December 1974 (1974-12-10) cited in the application abstract column 1, line 52 -column 2, line 30 column 2, line 60 - line 65 column 3, line 36 - line 39 claims 1,2,6,12	1,12-14
Y A	EP 0 816 515 A (GUTEHOFFNUNGSHUETTE MAN ;HUNDT & WEBER (DE)) 7 January 1998 (1998-01-07) abstract column 1, line 3 - line 23 column 2, line 13 - line 53 column 3, line 38 - line 43 claim 1; figure 2	1,12-14 4

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 July 2000	02/08/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Ceulemans, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte[redacted]al Application No
PCT[redacted] 00/03505

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 29 51 640 A (MASCHF AUGSBURG NUERNBERG AG) 2 July 1981 (1981-07-02)	1,13,14
A	claims 1-3 page 3, paragraph 1 page 6, paragraph 2 -page 7, paragraph 1 page 8, paragraph 6 -page 9	2,4
A	MCKOON R H: "A COMPARISON OF THE HEAT TRANSFER CAPABILITIES OF TWO MANUFACTURING METHODS FOR HIGH HEAT FLUX WATER COOLED DEVICES" 1986 , PROCEEDINGS OF THE CONFERENCE ON ELECTRON BEAM MELTING AND REFINING, PAGE(S) 45-52 , ENGLEWOOD, NJ, USA XP000863524 abstract; figure 2 page 46, paragraph 4 -page 47, paragraph 1	1-3,14
A	US 4 437 651 A (CORDIER JEAN ET AL) 20 March 1984 (1984-03-20) the whole document	1,4,5, 10,11, 13,14
A	US 4 938 456 A (RICHARDS RAYMOND E) 3 July 1990 (1990-07-03) claims 1,2,6,8; figures 1,3,5,6	1,4,5, 11,13
A	EP 0 196 432 A (GUTEHOFFNUNGSHUETTE MAN) 8 October 1986 (1986-10-08) the whole document	1,4-9

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 00/03505

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3853309 A	10-12-1974	GB 1424532 A	11-02-1976
		AR 197029 A	08-03-1974
		AU 467449 B	04-12-1975
		AU 5345273 A	19-09-1974
		BE 796974 A	16-07-1973
		CA 989587 A	25-05-1976
		CH 576831 A	30-06-1976
		DD 103580 A	05-02-1974
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		IT 981492 B	10-10-1974
		JP 49005825 A	19-01-1974
		LU 67239 A	22-05-1973
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		ZA 7301865 A	19-12-1973
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		CA 2209682 A	05-01-1998
		US 5904893 A	18-05-1999
DE 2951640 A	02-07-1981	NONE	
US 4437651 A	20-03-1984	FR 2493871 A	14-05-1982
		AT 11570 T	15-02-1985
		CA 1154590 A	04-10-1983
		DE 3168672 D	14-03-1985
		EP 0052039 A	19-05-1982
		JP 1398179 C	07-09-1987
		JP 57110606 A	09-07-1982
		JP 62001441 B	13-01-1987
US 4938456 A	03-07-1990	NONE	
EP 0196432 A	08-10-1986	DE 3507182 A	04-09-1986
		AT 52846 T	15-06-1990
		DE 3671286 D	21-06-1990
		JP 61223485 A	04-10-1986

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

HANSEN, Willem Joseph M.
CORUS TECHNOLOGY BV
P.O. Box 10000
NL-1970 CA IJmuiden
PAYS-BAS

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	04.05.2001
Applicant's or agent's file reference	IMPORTANT NOTIFICATION
HO990PCT/Ha/H	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP00/03505	13/04/2000	20/04/1999

Applicant
DANIELI CORUS TECHNICAL SERVICES BV et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Eich, M Tel.+49 89 2399-7578

Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
HO990PCT/Ha/H		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP00/03505	13/04/2000	20/04/1999

International Patent Classification (IPC) or national classification and IPC
C21B7/10

Applicant
DANIELI CORUS TECHNICAL SERVICES BV et al.

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
18/10/2000	04.05.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Noske, W Telephone No. +49 89 2399 8448

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP00/03505

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-6 as originally filed

Claims, No.:

1-14 as originally filed

Drawings, sheets:

1/2,2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-14
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-14
Industrial applicability (IA)	Yes:	Claims	1-14
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

1. Nearest prior art

D1 EP-A-816515, abstract,

discloses a cooling panel 1 for a shaft furnace; the panel 1 has at least one vertical duct 3, the ends of which are connected to connection ends 4 which run transversely with respect to the plane of the cooling panel 1. The duct 3 and the connection ends 4 are formed from continuous tubes of Cu (i.e. of a Cu alloy). On the side remote from the connection ends 4, the panel 1 is provided with a series of horizontal ribs 7. The panel 1 consists of Cu which is cast around the tubes 3, 4.

The subject-matter of claim 1 differs in substance from the panel of D1 only in that the Cu alloy forming the the tubes 3, 4 has an "Ni content ≥ 28 wt%".

In that all the claims 1-14 comprise the novel feature with respect to the material of the tubes novelty is given.

The effect of the novel feature lies in that the material of the tubes melts at a higher temperature than the material of the panel.

The novel feature with respect to the material of the circulating tubes forming part of a cooling panel of Cu cast around the tubes is disclosed in

D2 Proceedings of the Conference on Electron Beam Melting, Englewood, NJ (US), 1986, p. 45-52, article of R.H. McKoon, abstract.

The article compares heat transfer characteristics of cooling panels made from copper comprising drilled channels for cooling water to those of cooling panels made from copper being cast over tubes consisting of Monel, the material specified in claims 1-3 of the application. The skilled person knows that Monel metal melts at a higher temperature than copper. The article arrives at the conclusion that the cooling plate made by the former technique has better heat transfer characteristics than that made from copper cast over the Monel tubes, which is, nevertheless, sufficient for temperatures up to 700°C.

In starting from D1 It is obvious in view of D2 to select Monel as taught by D2 as the Cu material used for the tubes 3, 4 of D1 if one desires the Cu alloy of the tubes to melt at a higher temperature than that of the surrounding casting of Cu. Claims 1-3 do thus not comprise anything inventive.

The same applies to claims 13, 14 which do not add any features which depart from cooling panels according to D1 and comprising tubes of Monel.

2. Dependent claims 4-12 only add features referring to the ribs (claims 4-9, 12) or to

the undulating shape of the panel (claims 10, 11), which features are not related to the Monel material of the tubes and would not appear relevant to the solution of any apparent problem. The subject-matter of these claims does thus also not involve an inventive step.

3. Prior art D1 and D2 is missing in the description, Rule 5.1(a) PCT.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
HO990PCT/Ha/H		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP00/03505	13/04/2000	20/04/1999
International Patent Classification (IPC) or national classification and IPC C21B7/10		
Applicant DANIELI CORUS TECHNICAL SERVICES BV et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
18/10/2000	04.05.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Noske, W Telephone No. +49 89 2399 8448

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP00/03505

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-6 as originally filed

Claims, No.:

1-14 as originally filed

Drawings, sheets:

1/2,2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-14
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-14
Industrial applicability (IA)	Yes:	Claims	1-14
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

1. Nearest prior art

D1 EP-A-816515, abstract,

discloses a cooling panel 1 for a shaft furnace; the panel 1 has at least one vertical duct 3, the ends of which are connected to connection ends 4 which run transversely with respect to the plane of the cooling panel 1. The duct 3 and the connection ends 4 are formed from continuous tubes of Cu (i.e. of a Cu alloy). On the side remote from the connection ends 4, the panel 1 is provided with a series of horizontal ribs 7. The panel 1 consists of Cu which is cast around the tubes 3, 4.

The subject-matter of claim 1 differs in substance from the panel of D1 only in that the Cu alloy forming the the tubes 3, 4 has an "Ni content $\geq$ 28 wt%".

In that all the claims 1-14 comprise the novel feature with respect to the material of the tubes novelty is given.

The effect of the novel feature lies in that the material of the tubes melts at a higher temperature than the material of the panel.

The novel feature with respect to the material of the circulating tubes forming part of a cooling panel of Cu cast around the tubes is disclosed in

D2 Proceedings of the Conference on Electron Beam Melting, Englewood, NJ (US), 1986, p. 45-52, article of R.H. McKoon, abstract.

The article compares heat transfer characteristics of cooling panels made from copper comprising drilled channels for cooling water to those of cooling panels made from copper being cast over tubes consisting of Monel, the material specified in claims 1-3 of the application. The skilled person knows that Monel metal melts at a higher temperature than copper. The article arrives at the conclusion that the cooling plate made by the former technique has better heat transfer characteristics than that made from copper cast over the Monel tubes, which is, nevertheless, sufficient for temperatures up to 700°C.

In starting from D1 It is obvious in view of D2 to select Monel as taught by D2 as the Cu material used for the tubes 3, 4 of D1 if one desires the Cu alloy of the tubes to melt at a higher temperature than that of the surrounding casting of Cu. Claims 1-3 do thus not comprise anything inventive.

The same applies to claims 13, 14 which do not add any features which depart from cooling panels according to D1 and comprising tubes of Monel.

2. Dependent claims 4-12 only add features referring to the ribs (claims 4-9, 12) or to

the undulating shape of the panel (claims 10, 11), which features are not related to the Monel material of the tubes and would not appear relevant to the solution of any apparent problem. The subject-matter of these claims does thus also not involve an inventive step.

3. Prior art D1 and D2 is missing in the description, Rule 5.1(a) PCT.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION** see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
H0990PCT/Zu/Kh		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP 00/ 03505	13/04/2000	20/04/1999
Applicant		
DANIELI CORUS TECHNICAL SERVICES BV et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
P[redacted]EP 00/03505

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C21B7/10 F27B1/24 F27D1/12 B22D19/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C21B F27B F27D B22D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3 853 309 A (WIDMER C) 10 December 1974 (1974-12-10) cited in the application abstract column 1, line 52 -column 2, line 30 column 2, line 60 - line 65 column 3, line 36 - line 39 claims 1,2,6,12	1,12-14
Y	EP 0 816 515 A (GUTEHOFFNUNGSHUETTE MAN ;HUNDT & WEBER (DE)) 7 January 1998 (1998-01-07)	1,12-14
A	abstract column 1, line 3 - line 23 column 2, line 13 - line 53 column 3, line 38 - line 43 claim 1; figure 2	4

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 July 2000	02/08/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Ceulemans, J

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
[redacted]EP 00/03505

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 29 51 640 A (MASCHF AUGSBURG NUERNBERG AG) 2 July 1981 (1981-07-02)	1,13,14
A	claims 1-3 page 3, paragraph 1 page 6, paragraph 2 -page 7, paragraph 1 page 8, paragraph 6 -page 9	2,4
A	MCKOON R H: "A COMPARISON OF THE HEAT TRANSFER CAPABILITIES OF TWO MANUFACTURING METHODS FOR HIGH HEAT FLUX WATER COOLED DEVICES" 1986 , PROCEEDINGS OF THE CONFERENCE ON ELECTRON BEAM MELTING AND REFINING, PAGE(S) 45-52 , ENGLEWOOD, NJ, USA XP000863524 abstract; figure 2 page 46, paragraph 4 -page 47, paragraph 1	1-3,14
A	US 4 437 651 A (CORDIER JEAN ET AL) 20 March 1984 (1984-03-20) the whole document	1,4,5, 10,11, 13,14
A	US 4 938 456 A (RICHARDS RAYMOND E) 3 July 1990 (1990-07-03) claims 1,2,6,8; figures 1,3,5,6	1,4,5, 11,13
A	EP 0 196 432 A (GUTEHOFFNUNGSHUETTE MAN) 8 October 1986 (1986-10-08) the whole document	1,4-9

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 00/03505

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3853309 A	10-12-1974	GB 1424532 A	11-02-1976
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